# Accessibility evaluation of Chats and Forums in e-learning environments

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*Abstract - Collaborative learning is useful for students in their learning process. Nowadays, most e-learning systems include Computer Supported Collaborative Learning (CSCL) tools like chats and forums; however, are they accessible for everybody? This paper presents a heuristic evaluation of accessibility of two CSCL tools (chat and forum) in four web-based, open-source Learning Content Management Systems (LCMS): Moodle, ATutor, dotLRN and Claroline. The evaluation results show that the CSCL tools evaluated present accessibility barriers which are a handicap for many students who want to use the LCMSs Moreover, some recommendations are offered in order to improve the accessibility of the evaluated tools. Considering these recommendations in the development of the evaluated tools, all students could participate actively in the collaborative tasks proposed by teachers.*

**Keywords:** Accessibility; Computer Supported Collaborative Learning Tools; Chats; Forums; Learning Content Management Systems.

## 1 Introduction

Nowadays, many educational centers combine their traditional learning based on face-to-face classes and electronic learning (e-learning) systems based on web sites [1]. These e-learning systems are created with Learning Content Management Systems (LCMS) or Virtual Learning Environments (VLE) [2]. It is software which facilitates the creation and management of courses. Among all their functionalities, LCMSs offer typically tools to share materials, to assess or to collaborate. With regard to the collaborative tools, which are usually named Computer Supported Collaborative Learning (CSCL) tools, there are many tools which help users in the collaborative process. Some of the most important CSCL tools are chats and forums, which are really useful for students. However, some students cannot access to these CSCL environments because they have accessibility barriers. As a result, these LCMSs do not accomplish with some educational laws.

The main goal of this research work is to answer the question: are the chat and forum of the most used LCMSs (Moodle, ATutor, dotLRN and Claroline) accessible for everybody? To achieve it, a heuristic accessibility evaluation is carried out from the point of view of World Wide Web Consortium (W3C) guidelines. Then, considering the obtained results, some recommendations are specified to improve the accessibility of the

evaluated tools.

## 2 State of art

### 2.1 Accessibility: laws and guidelines

Everybody has the right to access to the Information Technologies (IT) in spite of their disabilities, age, technical environment or circumstances. Thus, there are different accessibility standards, guidelines and laws which try to normalize or regulate access to ITs and learning environments.

From the point of view of IT laws, United States of America (USA) has created a law to protect the rights of people with disabilities, Section 508 [3] and Europe developed the Recommendation 2006/952/EC on the Protection of Minors and Human Dignity in Audiovisual and Information Services [4].

On the other hand, there are laws and recommendations which enshrine the rights of every student, nevertheless of their abilities and functional diversity. For instance, the United Nations Educational, Scientific and Cultural Organization (UNESCO) conventions, recommendations and declarations [5] and the Convention on the Rights of People with Disabilities [6], in particular article 24 on education, consider that discrimination in education is a violation of the human rights. Moreover, United Kingdom has specified the law Disability Discrimination Act (DDA) [7]for education and USA has created the law Individuals with Disabilities Education Act (IDEA)[8]

With regard to the accessibility standards and guidelines that LCMSs must accomplish, W3C provides some accessibility guidelines like Authoring Tool Accessibility Guidelines (ATAG)[9] and Web Content Accessibility Guidelines (WCAG)[10], which has been converted in a ISO standard the ISO/IEC 40500:2012 Information technology -- W3C Web Content Accessibility Guidelines (WCAG) 2.0[11]

### 2.2 Computer supported collaborative learning tools and accessibility barriers

CSCL tools provide teachers and students benefits such as: share information and knowledge; facilitate the communication between them or allow them to participate in their learning process in an effective way [12]. Chat and Forum are two of the most useful CSCL tools in e-learning systems [13]. These tools allow students to exchange information and to communicate with other students or teachers easily.

Currently, an active participation in these CSCL tools is really useful for students and this participation is even taken into account for the final marks by some teachers [14]. However, some students cannot access to these tools because they present accessibility barriers. Previous studies have detected that the basic functions of LCMSs usually present accessibility barriers [15].

Specifically in CSCL tools, preliminary evaluations detected the main accessibility problems that forums and chats have [16]. These problems are explained in detail in this research work.

With regard to Chats, some specific accessibility barriers have been detected in previous research works. For instance, screen reader users have accessibility problems if the website is auto-refreshing continuously and it is not tagged properly because it causes the screen reader restarts [17]. Moreover, if the user is not informed about new opened Windows or new created buttons the user can be disoriented [18]. Besides, if one of the emitters is not able to write quickly, he could not be able to follow the conversation [19].

On the other hand, Forums present also specific accessibility barriers because these tools used to have a What You See Is What You Get (WYSIWYG) feature which is not accessible for some users [20]. Furthermore, this tool allows users to create content and, if the user is not an accessibility expert, s/he could generate inaccessible content. For instance, s/he could use tables for layout or colors without a minimum contrast [21].

However, none of these previous evaluations carried out heuristic accessibility evaluations of these tools from the point of view of W3C guidelines. Thus, the main goal of this research is to detect the main accessibility barriers that people have to face when use these tools in four of the most used CSCL environments.

# 3 Evaluation

The details of the heuristic evaluation of accessibility carried out in this study are described in next subsections.

## 3.1 Evaluation objective and environment

The main objective of the paper is to evaluate the accessibility of a synchronous and an asynchronous tool because they have different ways of interaction. Previous studies have demonstrated the usefulness of the chat and forum as synchronous and asynchronous CSCL tools respectively. Thus, this research is focused on the evaluation of the chat and forum tools in the selected e-learning systems from the point of view of accessibility. Moreover, as the study reveals accessibility barriers, some recommendations are specified to correct them.

With regard to the LCMSs selected, four of the most used web-based, open-source LCMS in the world have been chosen for the comparative study: Atutor 2.0.3[1], Claroline 1.10.6 [2], dotLrn 2.4[3] and Moodle 2.0.5[4]. Furthermore, all of them take into account accessibility in their development.

The accessibility evaluation includes two different perspectives: one evaluates the accessibility of the interface in all CSCL tools; and the other evaluates the accessibility of the CSCL tool as an authoring tool.

Thus, to achieve it the WCAG 2.0 (Web Content Accessibility Guidelines)[10] and the ATAG 2.0 (Authoring Tool Accessibility Guidelines)[9] are considered. These guidelines are divided into different priority levels, from A to AAA. For this evaluation, the priority level selected is the AA conformance level because it is the minimum accessibility level required by the law; thus, the tool should accomplish with the A and AA guidelines.

## 3.2 Method for evaluation

A heuristic evaluation has been carried out by three different accessibility experts. According to the methodology and recommendations of W3C [22], the interface evaluation of the CSCL tools was conducted automatically, semi-automatically and manually from the perspective of WCAG 2.0. In this case, the automatic tools used were TAW[5] and Hera[6] and the semi-automatic tool was WAVE[7].

On the other hand, the accessibility evaluation of the CSCL tools from the point of view of an authoring tool was carried out manually and with the help of semi-automatic tools according to the ATAG 2.0 draft guidelines. Considering that, to the knowledge of the authors of this article, no automatic tools exist currently for this kind of evaluations but the semi-automatic tool WAVE was used.

## 3.3 Evaluation results

This section presents the main results obtained in the heuristic evaluation. These results indicate that accessibility barriers are presented in the CSCL tools of each LCMS evaluated. Actually, the analysis of the findings shows that none of the collaborative tools accomplish even the A priority level of WCAG or ATAG guidelines.

The obtained results are summarized in Table 1. The errors have been categorized in general errors (E1 to E14) depending on the nature of the error. For instance, the category E1 groups the WCAG 2.0 and ATAG 2.0 guidelines which are related with non-textual content. Thus, it considers that non-textual content in the system should need alternative information in order to be accessible. Table 1 shows the Code of error (name of the category) and the WCAG 2.0 and ATAG 2.0 guidelines which are related to this category. For instance, guidelines 1.1.1, 1.2.1, 1.2.2, 1.2.3, 1.2.5 and 4.1.2 of WCAG 2.0 and guidelines A.1.1.1, A.1.2.1, A.1.2.2, A.2.1.1 and A.2.1.2 of ATAG 2.0.

On the other hand, Table 2 and Table 3, which are showed in the Annex 1, detail the errors found in the CSCL tools and how they have been categorized in this paper (code and description).

According to the results, the most accessible chat tools are the chats of Moodle and ATutor, because they accomplish more guidelines of A priority level than the others tools. Moreover, they try to solve one of the specific accessibility problems of chats, the auto-refresh.

On the other hand, the most accessible forum is the forum in DotLRN because it is the tool which fulfills more accessibility guidelines of A priority level. However, all of the tools present accessibility problems and none of them help the author to create accessible content.

A complete list of accessibility barriers presented in each collaborative tool for each LCMS can be found at the website http://labda.inf.uc3m.es/Evaluations [8].Next, the main accessibility barriers found are explained for each CSCL tool: chat and forum.

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[1] Atutor. http://atutor.ca/atutor/ (May 2013)

[2] Claroline. http://www.claroline.net/?lang=en (May 2013)

[3] dotLrn. http://www.dotlrn.org/index.html (May 2013)

[4] Moodle. https://moodle.org/ (May 2013)

[5] TAW. http://www.tawdis.net/ (May 2013)

[6] Hera http://www.sidar.org/hera/ (May 2013)

[7] Wave. http://wave.webaim.org/ (May 2013)

[8] Password: EVALUATIONS

**Table 1. Relationship between errors categories and WCAG and ATAG guidelines**

| Code | WCAG 2.0 | ATAG 2.0 |
|---|---|---|
| E1_ NonTextualContent | 1.1.1;1.2.1;1.2.2; 1.2.3;1.2.5; 4.1.2 | A.1.1.1;A.1.2.1; A.1.2.2;A.2.1.1; A.2.1.2 |
| E2_ Information | 1.3.1;1.3.2 ;1.4.3 2.4.2;2.4.4;2.4.5 2.4.6;2.4.7;3.1.1 3.1.2;3.2.2;3.2.3 3.3.2 | A.1.1.1;A.1.2.1 A.1.2.2 |
| E3_ Sensorial | 1.3.3;1.4.1 | A.1.1.1;A.1.2.1 A.1.2.2 |
| E4_ Focus | 2.4.3;2.4.7 | A.1.1.1;A.1.2.1 A.1.2.2 |
| E5_ Personalization | 1.4.2;2.2.1;2.2.2 | A.1.1.1;A.1.2.1 A.1.2.2;A.3.2.2 A.3.3.1;A.3.6.2 |
| E6_ Keyboard | 2.1.1;2.1.2;2.4.1 2.4.3; 3.2.2 | A.1.1.1;A.1.2.1 A.1.2.2;A.3.1.1 A.3.1.2;A.3.1.3 |
| E7_ ControlErrors | 3.3.1;3.3.3 | A.1.1.1;A.1.2.1 A.1.2.2 |
| E8_ StandardErrors | 4.1.1 | A.1.1.1;A.1.2.1 A.1.2.2 |
| E9_ EditingViews | -- | A.1.1.1;A.1.2.1 A.1.2.2,A.2.2.1 A.2.2.2,A.3.4.1 A.3.5.1, A.3.7.1 |
| E10_ ImproveSession | -- | A.3.2.1, A.3.2.2 |
| E11_ Documentation | -- | A.4.2.1, A.4.2.2; B.2.4.1 |
| E12_Genaration Accessible Content | -- | B.1.1.1;B.1.1.2 B.1.2.2,B.1.2.1 B.1.2.4 |
| E13_ Produce Accessible Content | -- | B.2.1.1;B.2.2.1 B.2.2.2;B.2.3.2 B.2.3.3;B.2.4.1 B.2.4.2;B.3.1.1 B.3.1.2 |
| E14_ AccessibilityFeatures | -- | B.4.1.1;B.4.1.3 B.4.1.4;B.4.1.5 B.4.2.1;B.4.2.2 |

### 3.3.1 Chat

With regard to the WCAG 2.0 guidelines, some errors can be highlighted in chats. All the non-textual content must contain alternative information; however, none of the tools provide a description for all images (E1). Moreover, the information is not well-structured or visualized (E2). For instance, the headers and the website title are not used properly in each chat tools evaluated. The Figure 1 DotLRN uses headers in an improper way because it specifies the left menu and not the page structure. Moreover, Moodle and Claroline do not follow a proper logic order and
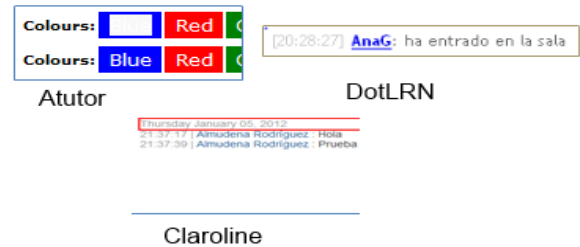
Atutor does not use headings in the chat but it is not showed because the result is null.

**Figure 1. Headings**
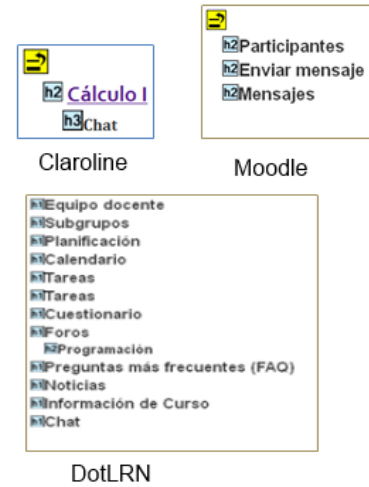


Besides, the contrast ratio is not the minimum in the chats except in Moodle (E3) as it is shown in the Figure 2 . Thus, the user is not able to distinguish the information showed in the chat.

**Figure 2. Contrast Ratio in Chats**



The focus is not visible in all the evaluated chats except of Moodle and the focus order is correct only in Claroline (E4). Related to the error category E5, all chats except the chat of Moodle and Atutor do not allow adjusting the timing. Thus, the time of the conversation cannot be stopped, paused or adjusted. For instance, as it is shown in the Figure 3, the Atutor chat allows the user to specify the time interval to refresh the chat and if the user prefers to refresh the chat manually. Moreover, the user can specify the sound of the new messages but he cannot disable the sound of new connected users, for example.

**Figure 3. Atutor Chat Preferences**
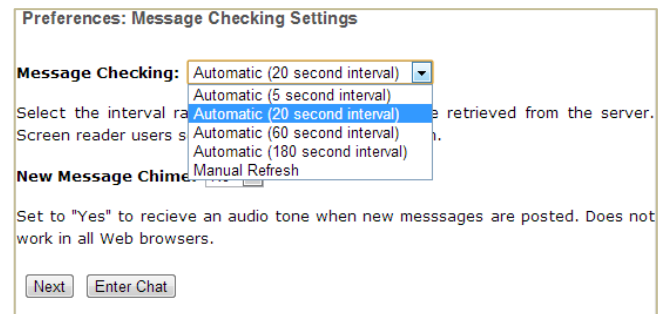


Other important error is that the user is not able to control any chat with the keyboard exclusively (E6). With regard to error E7, Claroline and Atutor do not check all the errors that the user

can commit. For instance, the user could send blank messages. Finally, all the tools have webpages which have not been developed using web standards as HTML or CSS (E8).

From the point of view of ATAG guidelines it is important to emphasize that this module produces fewer content than forums. Thus, there are fewer accessibility guidelines which are not fulfilled. The first guideline of the ATAG makes a reference to the accomplishment of the WCAG; so, as it has been explained before, there are many WCAG guidelines (errors from E1 to E8) which are not fulfilled. Moreover, when the authoring tool generates content, this content is not accessible (E12) as it is shown in the figures, Figure 1 and Figure 2; Furthermore, the author cannot check the accessibility of the content created by himself automatically or semi-automatically (E13) because there is not functionalities for it. Finally, the documentation of the e-learning tools does not provide accessibility information to inform the user about the accessibility functionalities and the accessibility problems that users can face when they use chats (E11, E14).

### 3.3.2 Forum

Regarding to the content, according to WCAG 2.0, a general error that exists in all the forums is that alternative text is not provided for the images and likewise subtitles or audio-descriptions files are not provided for the uploaded videos (E1). Moreover, there are not elements to make the navigation easier within the application and some pages do not have an appropriate title (E2). Also, Claroline, Moodle and DotLRN use colors to represent the elements that are enabled or disabled (E3). The Figure 4 shows the WYSIWYG Editors of Claroline, Moodle and DotLRN which use colors to represent the enabled or disabled buttons. Besides, there are elements which are not accessible and manageable through keyboard and the focus is not visible (E4, E6). For instance, the WYSIWIG editors used in the LCMSs are not accessible by keyboard (see Figure 4).

**Figure 4. WYSIWYG Editors**
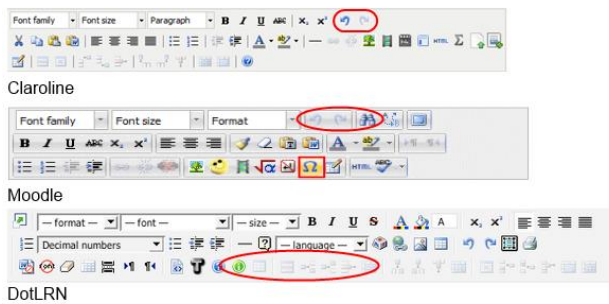
Finally, ATutor does not allow to personalize the audio (E5), Claroline does not control the errors produced by the users (E7) and all the tools evaluated have bugs in the code and style sheet (E8).

Considering the ATAG 2.0 guidelines, all the tools have accessibility problems related to the WCAG (errors from E1 to E8). Thus, they do not accomplish the first guideline of the ATAG. Claroline and Atutor do not show the status messages and the text presentation in a programmatic way and all tools, except Moodle, do not allow searching through the content (E9). Moreover, ATutor cannot preview the content properly (E9) and Claroline does not auto-save the content (E10). The tools evaluated do not provide a mechanism to verify the accessibility of that content and the generated content is not accessible (E12). Furthermore, the tools do not suggest and serve as a guide to the author, in the same way it must warn about accessibility errors when needed (E13). For

instance, Claroline allows users to include templates in the generated content. However, this content is not accessible because it includes a table for layout as it is shown in the Figure 5 and the template does not specify its accessibility level.

**Figure 5. Insert Predefined Template Content**
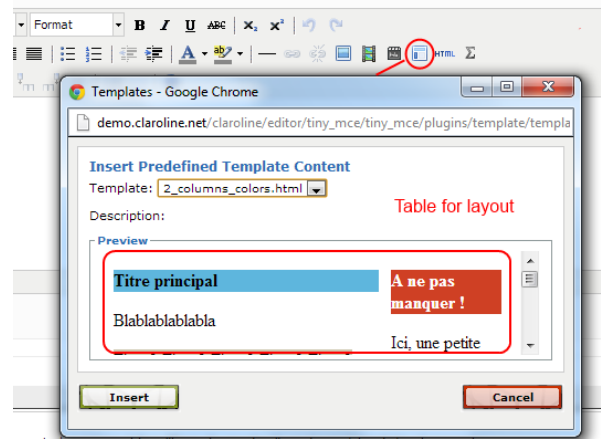
Moreover, ATutor provides accessibility features; however, these features are not activated by default, see error E14.

**Figure 6. Accessibility Features Are Not Activated by Default**
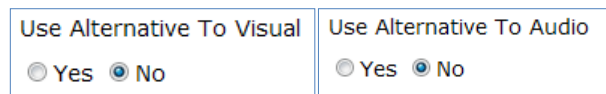
Finally, none of the tools provide clear and complete instructions about the use of the tool, including accessibility examples and documentation related to the accessibility (E11, E14).

## 4 Recommendations

Considering the evaluation results obtained from this research work, a set of recommendations has been elaborated in order to improve the accessibility of the chat and forum tools for the four LCMS. A summary of them is list next:

- **Provide textual information:** The chat and the forum should provide textual information for the non-textual content showed in the interface. For instance, every image should have alternative content, every video uploaded should include subtitles and audio-description and every text input should have a label associated.

- **Keyboard:** The CSCL tools should be controlled completely through keyboard. For instance, users who cannot use the mouse would not have any handicap to use it.

- **Skip content:** The CSCL tools should include mechanisms to skip content or use shortcuts.

- **Avoid errors:** The tools should help the author to avoid errors like sending blank messages or creating inaccessibility content. It is important to remark that authors could not be accessibility experts and even expert users can commit errors.

- **Web standards:** All the webpages and style sheets should be created without code errors and according to web standards like HTML, CSS, etc.

- **Check accessibility:** The tools should inform the authors about the accessibility errors and how to solve them.

- **Accessibility documentation:** The tools should provide documentation related to accessibility features and how to create accessible content as well as complete documentation about the entire tool.

Specifically for the chat tool, due to its synchronous character, it is really important for the users to be able to stop, control and adjust the time of auto-refreshing the sentences. Thus, users could be able to follow the conversation without any problem.

Finally, the forum tool should check the accessibility of the content generated by the authors. Thus, the tool should control the accessibility automatically and inform the authors when there were accessibility errors in their content and how to solve them. Moreover, the tool should allow searching through the content and if the tool allows previews of the content, the previewed content should be showed properly.

# 5 Conclusion

The study presented in this paper lay out the accessibility barriers that students and teachers usually face when using chat and forum as CSCL tools in e-learning systems and offers a set of general and specific recommendations to solve these barriers.

This comparative study is based on a heuristic evaluation of four of the most used LCMSs worldwide: Moodle, Atutor, Claroline and dotLRN. The research concludes that every CSCL tool in each LCMS present accessibility barriers. The most accessible chat tools are the ones of Atutor and Moodle, which also incorporate ways to control the auto-refresh of the website. On the other hand, the most accessible forum tool is the DotLRN forum because it accomplishes more guidelines of A priority level,

Currently we are working in evaluating the accessibility of other collaborative tools in e-learning systems and moreover we are preparing a user evaluation of all these tools.

# 6 Acknowledgments

# 7 References

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# 8 Annex 1

The Annex shows the errors found in the evaluation and they are summarized in Table 2 and Table 3. These tables are divided into four columns: Code, Description, Important Errors and Tools. The first column shows the code of the error. These codes are the groups in which the errors of the column *Important Errors* are grouped. To carry out this aggrupation, it has been considered the experience of the authors according to the nature of the errors. The column *Description* specifies more information about the error shown in the column *Code*. Finally, the column *Tools* specifies which are the tools that present this error.

**Table 2. Error description and code of the Accessibility Problems Found in Chats and Forums. Errors E1-E7**

| Code | Description | Important Errors | Tools* |
|---|---|---|---|
| E1_ NonTextual Content | The non-textual content does not have alternative information | The images do not have alternative content or do not ask you to provide them. (A) | All |
| | | Videos or audio cannot be uploaded with alternative content. (A) | MF\| DF\| CF \|AF |
| | | There are not labels for input text. (A) | All |
| E2_ Information | The information is not well structured, visualized or represented. | Headers are not used properly. (A) | All (Ex. AF) |
| | | The title is not descriptive. (A) | All (Ex. CC) |
| | | The links are not descriptive and there are link icons without identification purpose. (A) | CF \| AF \| AC |
| | | Multiple ways of navigation (AA) | AC |
| | | Coherent navigation (AA) | CF \| CC |
| | | Website language (A \|AA) | All (Ex. AF\| AC) |
| | | Meaningful Sequence and visible focus. (A\|AA) | CF\| CC\| DF \| DC |
| | | The tool uses pop-ups (A) | MF\| MC\| CF\| CC |
| | | The text contrast between text and background is not minimum (AA) | MF\| MC\|DF |
| E3_ Sensorial | There is information which is related to colors, shapes, etc. | There are icons which are not specified with text. (A) | All |
| | | The tool uses color to specify information. (A) | CF \| DF\| MF \| MC |
| E4_ Focus | The focus cannot be seen | Visible focus (AA) | CF \| DF \| DC |
| | | Focus order (A) | AF \| AC \| CF |
| E5_ Personalization | The user cannot personalize the content or features | The user cannot control the audio. (A) | AF \| AC |
| | | The user cannot personalize the autorefresh (A) | DC \| CC |
| | | The time session is not adjustable. (ATAG) (A) | CF \| CC |
| | | Visual information cannot be stopped (ATAG) (A) | AF \| AC |
| | | The author settings are not preserved (ATAG) (A \|AA) | AF \| AC |
| E6_ Keyboard | The user cannot access to all the information through keyboard | There are elements which cannot be selected or there are keyboard traps. (A) | All (Ex. DF\| CC) |
| | | The web cannot be navigated sequentially by keyboard (A) | MF\| MC\| AC |
| | | There are no mechanisms to skip content. (A) | CF \| CC |
| | | There are no shortcuts or they are overlapped (ATAG) (AA) | AC \| CF \| CC |
| E7_ ControlErrors | The tool does not inform the user about errors | The user can send information without text and the tool does not alert about it. (A \|AA) | CF \| CC \| AC |
| | | The user cannot cancel the action. (A) | DC |

*Values: Moodle Forum (*MF*); Moodle Chat (*MC*); dotLRN Forum (*DF*); dotRN Chat (*DC*); ATutor Forum (*AF*); ATutor Chat (*AC*); Claroline Forum (*CF*); or Claroline Chat (*CC*); *All* if all tools present this error; or *All (Ex: XY)* which means that all the evaluated tools have the error except the tools specified in the parenthesis.

**Table 3. Error description and code of the Accessibility Problems Found in Chats and Forums. Errors E8-E14**

| Code | Description | Important Errors | Tools* |
|------|-------------|------------------|--------|
| E8_ StandardErrors | The tool does not accomplish standards and guidelines | The HTML and CSS code contain errors (A) | All (Ex. MF \| MC) |
| E9_ EditingViews | The editing view is not accessible | The editing view does not show the status messages or the text presentation in a programmatically way. (A) | CF\| CC\| AF\| AC |
| | | The user cannot navigate through content structures. (AA) | All (Ex. CC) |
| | | Text search through the content (AA) | MF\| DF\| AC\| CF |
| | | The content cannot be previewed properly. (A) | AF |
| E10_ ImproveSession | The tool does not autosave the information. | The tool does not autosave the information. (A) | CF \|CC |
| E11_ Documentation | Accessibility documentation | The documentation is not complete and does not include information related to accessibility (A\|AA) | All |
| E12_ Generation Accessible Content | Fully automatic processes must produce accessible content | The generated content during session is not accessible. (A) | All (Ex. CC) |
| | | The content generated after session is not accessible (A) | MF\|MC\|DF\|DC |
| | | Transformations and copies do not preserve the accessibility (A) | CF \| AF \|AC |
| E13_ ProduceAccessibleContent | Authors must be supported in producing accessible content | The author has restrictions which do not allow him to create accessible content (A) | AF \| CF |
| | | Authors are not guided to produce accessible content (A) | CF\| CC\| AF\| AC |
| | | The tool does not check the accessibility (A) | All |
| | | The tool provide default alternative text which does not identify the element (A) | AF |
| | | Templates are not accessible and do not specify its accessibility level. (A) | All (Ex. CC) |
| E14_ AccessibilityFeatures | Authoring tools must promote and integrate their accessibility features | The accessibility features are not activated by default (A) | AF\| AC |
| | | If the user deactivates an accessibility function the tool does not inform about the problem. (AA) | AF\| AC |
| | | The tool does not inform about accessibility of each format and does not check it. (AA) | All |
| | | There is not documentation related to accessibility and how to implement it (A) | All |

*Values: Moodle Forum (*MF*); Moodle Chat (*MC*); dotLRN Forum (*DF*); dotRN Chat (*DC*); ATutor Forum (*AF*); ATutor Chat (*AC*); Claroline Forum (*CF*); or Claroline Chat (*CC*); *All* if all tools present this error; or *All (Ex: XY)* which means that all the evaluated tools have the error except the tools specified in the parenthesis.